CLAIMS

1. A semiconductor device comprising:

a wide-gap bipolar semiconductor element using a wide-gap semiconductor and having a built-in voltage in the forward direction,

a semiconductor package accommodating said wide-gap bipolar semiconductor element and having electrical connection means for connecting said wide-gap bipolar semiconductor element to external apparatuses, and

heating means for keeping said wide-gap bipolar semiconductor element inside said semiconductor package at a predetermined temperature higher than ordinary temperature.

2. A semiconductor device in accordance with claim 1, wherein said predetermined temperature is a temperature higher than the temperature at which the decrement of the steady loss of said wide-gap bipolar semiconductor element corresponding to the decrement of the built-in voltage lowering depending on the temperature rise of said wide-gap bipolar semiconductor element is larger than the increment of said steady loss corresponding to the increment of the ON resistance increasing depending on said temperature

rise.

3. A semiconductor device in accordance with claim 1 or 2, wherein the life time of carriers in said wide-gap bipolar semiconductor element has been adjusted in advance so as to be within a predetermined range by irradiation of at least one of a gamma ray, an electron beam or a charged particle beam.

4. A semiconductor device in accordance with claim 1 or 2, wherein the life time of carriers in said wide-gap bipolar semiconductor element has been adjusted in advance so as to be within a predetermined range by irradiation of an electron beam at an irradiation energy in the range of 0.1 MeV to 20 MeV and at the amount of irradiation in the range of $5 \times 10^{11}/cm^2$ to $5 \times 10^{14}/cm^2$ in terms of the number of electrons per unit area.

5. A semiconductor device in accordance with claim 1, wherein said heating means heats said wide-gap bipolar semiconductor element to a predetermined temperature higher than 50°C in advance before the start of the operation of said wide-gap bipolar semiconductor element.

6. A semiconductor device in accordance with claim 1, 2 or 5, wherein said predetermined temperature is 125°C or more.

7. A semiconductor device in accordance with claim 1, wherein said heating means is an electric heater provided to give heat said wide-gap bipolar semiconductor element.

8. A semiconductor device in accordance with claim 1, wherein said heating means is a heat sink that raises the temperature of said wide-gap bipolar semiconductor element to 125°C or more by controlling the radiation of heat generated when said wide-gap bipolar semiconductor element is energized.

9. A semiconductor device in accordance with claim 1, wherein said heating means is a heat sink that raises the temperature of said wide-gap bipolar semiconductor element to the temperature at which the decrement of the steady loss of said wide-gap bipolar semiconductor element corresponding to the decrement of the built-in voltage lowering depending on the temperature rise of said wide-gap bipolar semiconductor element is larger than the increment of said steady loss corresponding to the increment of the

ON resistance increasing depending on said temperature rise by controlling the radiation of heat generated when said wide-gap bipolar semiconductor element is energized.

10. A semiconductor device in accordance with claim 1, wherein said semiconductor package has a temperature sensor and a temperature controller that keeps the temperature of said wide-gap bipolar semiconductor element at said predetermined temperature on the basis of the detection output of said temperature sensor.

11. A semiconductor device in accordance with one of claims 1 to 6, wherein said wide-gap bipolar semiconductor element is either a diode having a pn junction or a self-excited thyristor.

12. A semiconductor device comprising:

a wide-gap bipolar semiconductor element using a wide-gap semiconductor,

a wide-gap photodiode provided so as to face said wide-gap bipolar light-emitting semiconductor element and to receive light emitted from said wide-gap bipolar light-emitting semiconductor element,

a package accommodating said wide-gap

bipolar light-emitting semiconductor element and said wide-gap photodiode and having electrical connection means for connecting said wide-gap bipolar light-emitting semiconductor element and said wide-gap photodiode to external apparatuses, and

heating means for keeping said package at a predetermined temperature higher than ordinary temperature.

13. A semiconductor device production method comprising:

a step of forming a drift layer of a second conductive type SiC having low impurity concentration on a cathode region of a first conductive type SiC having high impurity concentration,

a step of forming a base region of a first conductive type SiC on said drift layer,

a step of forming an anode region of a second conductive type SiC on said base region, and

a step of irradiating an electron beam having predetermined irradiation energy to said cathode region, drift region, base region and anode region at a predetermined electron density.

14. A semiconductor device production method comprising:

a step of forming a drift layer of a first conductive type SiC having low impurity concentration on a cathode region of a first conductive type SiC having high impurity concentration,

a step of forming an anode region of a second conductive type SiC on said drift layer,

a step of providing an anode electrode on said anode region,

a step of providing a cathode electrode on said cathode region, and

a step of generating stacking faults in said drift layer and anode region by passing a predetermined forward current for a predetermined time across said anode electrode and cathode electrode.

15. A power conversion apparatus comprising:

a GTO thyristor element using a wide-gap semiconductor,

a diode element using a wide-gap semiconductor and connected in reverse parallel to said GTO thyristor element,

a package accommodating said GTO thyristor element and said diode element, and having electrical connection means for connecting said GTO thyristor element and said diode element in reverse parallel and for connecting said GTO thyristor element and said

diode element having been connected in reverse parallel to external apparatuses,

switching modules, each having heating means for keeping said GTO thyristor element and diode element in said package at a predetermined temperature higher than ordinary temperature,

a switching circuit in which three series connections, each comprising at least two said switching modules connected in series, are connected in parallel between the positive pole and the negative pole of a DC power source, and

a control circuit, provided for each of said switching modules, for controlling the operation of said switching circuit after each switching module is heated by said heating means and the temperature of each switching module reaches a predetermined temperature.

16. A power conversion apparatus in accordance with claim 15, wherein said heating means is at least one of heating means for heating said package and a heat sink for controlling heat radiation from said package.